

## Vector Problems

Let  $\vec{a} = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$ ,  $\vec{b} = \begin{pmatrix} 0 \\ -1 \\ 2 \end{pmatrix}$ ,  $\vec{c} = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$ , and  $\vec{d} = \begin{pmatrix} 1 \\ t \\ t^2 \end{pmatrix}$ .

1. Compute

(a)  $\vec{a} + 2\vec{b}$

(b)  $\|\vec{b} - \vec{d}\|$

(c)  $\vec{c} \cdot \vec{d}$

(d) the angle between  $\vec{a}$  and  $\vec{c}$

(e) The line through  $P(3, 2, 1)$  and parallel to  $\vec{b}$ .

(f)  $\vec{b} \times \vec{c}$

(g) Find a vector perpendicular to both  $\vec{c}, \vec{d}$ .

2. Find the vertex  $E$  in the parallelogram  $ABCE$ , where  $A(1, 0, 0), B(0, -1, 2), C(3, 2, 1)$ .

3. Find real numbers  $s, t$  such that  $\vec{c} = s\vec{a} + t\vec{b}$ .

4. (a) Find the equation of the line  $l$  through  $A(1, 0, 1), B(0, -2, 3)$

(b) Find the equation of the plane through  $A$  and perpendicular to  $l$ .

5. (a) Orthogonally project  $\vec{b}$  onto  $\vec{c}$ :

Find the decomposition  $\vec{b} = \vec{b}'' + \vec{b}^\perp$

(b) Orthogonally project  $\vec{c}$  onto  $\vec{b}$ :

Find the decomposition  $\vec{c} = \vec{c}'' + \vec{c}^\perp$

6. Find the distance of point  $D(1, 0, -3)$  from the plane  $2x - 3y + z - 5 = 0$ . Does  $D$  lie above or below the plane?

7. Do problem 6.13 number 5 with  $A(1, 0, 0), B(-3, 0, 1), C(2, 2, 2)$ .

8. Do the planes  $2x - 3y + z = 5 = 0$  and  $-x + y + 2z - 3 = 0$  intersect and if so, find the line of intersection.

9. Do problem 6.13 number 8 with  $A(1, 0, 0), B(-3, 0, 1), D(2, 2, 2), E(3, 1, 2)$ .